APPENDIX E

ADM CCS #1

MECHANICAL INTEGRITY LOG AND TESTING DESCRIPTIVE REPORT

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Mechanical Integrity Log and Testing Descriptive Report

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This document will describe the logging and testing programs related to the mechanical integrity of this well. It will also contain the analysis of the data collected, with the goal of demonstrating that the well is mechanically sound, and that no fluids will flow into the USDW at this site.

The Casing and Logging Program

Three casing strings were run in the ADM CCS #1 well. Logging runs investigating and verifying the baseline mechanical integrity of each casing string were made, and will be discussed in this document. Many other types of logs were run during installation of the borehole for the purpose of characterizing site geologic conditions. A discussion of those logs is available in the well completions report.

The surface casing string was run from surface to 353 ft and consisted of 20.0 inch, 94 lb/ft casing. The intermediate casing string was run from surface to 5339 ft and consisted of 13 3/8 inch, 59.5 and 66.2 lb/ft casing. The production casing string was run from surface to 7219 ft and consisted of 9 5/8 inch 40 lb/ft casing down to 5273 ft, and 9 5/8 inch 47 lb/ft CR13 chrome casing from 5273 ft to TD at 7219. All three casing strings were cemented to surface. Figure 1 is a wellbore diagram showing the casing configuration.

A Cement Bond Log (CBL) was run in each of the casing strings to help evaluate the cement of each casing string. The CBL transmits a sonic signal from a transmitter, and then measures the amplitude of that sonic signal after traveling through a section of the casing. If there is cement in the casing annulus the amplitude of the sonic signal will be attenuated and the amplitude of the sonic signal measured will be small. How small the amplitude actually becomes is dependent on many factors, including the percent of the casing bonded, the type of cement, and many of the casing properties to name a few.

To evaluate the casing and cement of the intermediate casing string an Ultrasonic Imager Tool (USIT) was used. The USIT uses a single transducer mounted on an ultrasonic rotating sub on the bottom of the tool. The transmitter emits ultrasonic pulses between 200 and 700 kHz and measures the received ultrasonic waveforms reflected from the internal and external casing interfaces. The rate of decay of the waveforms received indicates the quality of the cement bond at the cement/casing interface, by computing an acoustic impedance of the material outside the casing. The time for the signal to be transmitted and reflected back to the transducer is used to measure the internal radius, and the resonant frequency of the casing provides the casing wall thickness required for pipe inspection. Because the transducer is mounted on the rotated sub, the entire circumference of the casing is scanned. This 360º data coverage enables the evaluation of the quality of the cement bond as well as the determination of the internal and external casing condition.

To evaluate the mechanical integrity of the production string of casing the Isolation Scanner tool was used in combination with the CBL and a Multi-finger Caliper Log (PMIT). The Isolation Scanner combines the same ultrasonic measurement as the USIT with a measurement of Flexural Wave Attenuation. The Flexural Attenuation measurement incorporates one ultrasonic transducer acting as the transmitter and two ultrasonic transducers acting as receivers to determine how much a flexural wave is attenuated after traveling through the casing. This measurement is more sensitive to cements that have low acoustic impedances than the USIT and can help identify when these cements are present. The measurements of acoustic impedance and flexural wave attenuation are combined into an interpretation breaking down the interpretation into solid (cement), liquid (water, mud, oil), and gas to make the visualization of the interpretation easy. The Multi-finger Caliper provides a baseline measurement of the internal radius as well as providing another measurement of the internal radius that can be compared to the measurement coming from the USIT.

Another log run that will be used to monitor changes in the mechanical integrity of the well is the Reservoir Saturation Tool (RST). This tool will primarily be used to monitor the CO_2 in the reservoir but also has several measurements that can be used to identify CO_2 that might be migrating up in any of the casing annuli. As expected, the base pass of the RST showed no indications of CO_2 present in any of the annuli. The portion of the log data that was related to the reservoir was consistent with the petrophysical analysis of the reservoir as described in the Geophysical Log Descriptive Report. The RST is most effective when used as a monitor log with subsequent monitoring passes. This is the base pass of the RST and these measurements will be compared to the same measurements on subsequent runs of the tool.

Analysis of the Well Integrity Logs

The CBL on the surface string of casing shows that at 352 ft. the amplitude measures just under 2 mv. This translates into an attenuation of 9 dB/ft. Using this value to compute the compressive strength of the cement at this interval, a value of approximately 3000 psi is computed. To demonstrate zone isolation it is desirable to have a continuous interval with the attenuation greater than 6 dB/ft. The attenuation is greater than 6 dB/ft from 354 to 347.5 ft. Ideally an interval longer than this would be preferred to indicate hydraulic isolation. However, there are several additional considerations. The CBL tool is designed for use in smaller casing, yet there are no better tools to evaluate the cement in this large casing. In addition to the zone mentioned above, several other intervals in the well have attenuations in the 4 to 6 dB/ft range where cement is certainly present. Also, it is known that cement was circulated to surface and that the cementing job was executed according to plan. Given this information it is believed the CBL is showing good hydraulic isolation at the base of the casing and a sufficient amount of cement behind the entire interval to prevent any fluids from flowing up from below into any USDW behind the casing in this interval as is the objective of this casing string.

The USIT shows that the intermediate string of casing has good hydraulic isolation over most of the length of the casing, with only short intervals where there are isolated pockets of fluid and not cement behind the casing. Figure 2 shows the results of the USIT and a brief description of the log is as follows:

Track1 – Gamma Ray and other QC type data.

Track 2 - Amplitude of the received ultrasonic signal (light colors are high amplitude)

Track 3 and 4 – Casing cross section showing minimum, maximum and average internal radius and average external radius.

Track 5 – Internal radius image

Track 6 – Minimum, maximum and average casing thickness.

Track 7 – Casing thickness image

Track 8 – Acoustic impedance image

Track 9 – Bond index presentation (yellow = cement, blue = liquid, red = gas, green = solid)

Track 10 – Interpreted acoustic impedance image (any shade of brown = cement, blue = liquid, red = gas, green = solid)

The USIT log also shows that the casing has no internal or external defects at this time based on the internal radius and thickness measurements.

The production string of casing was also determined to have good hydraulic isolation over most of the length of the casing, with only short intervals where there are isolated pockets of fluid and not cement behind the casing. The top of the injection zone is 5544 ft. and the first of these intervals below this point that has any potential to flow fluids is from 5660 to 5664 ft. It is actually more likely that this zone has a thin cement sheath rather than a channel. The next interval below this that is not completely isolated is from 6760 to 6750 ft. Above the base of the confining layer the first potential channel would be just above 4900 ft. Therefore, there is no potential for any fluids to migrate from the injection zone to zones above the confining layer by way of the casing-formation annulus. Figure 3 shows the Isolation Scanner log on this casing string and a brief description is as follows:

Track1 – Gamma Ray and other QC type data.

Track 2 – Diagnostic track – the processing of the tool is model based and this track indicates any deviations of the model.

Track 3 - Amplitude of the received ultrasonic signal (light colors are high amplitude)

Track 4 and 5 – Casing cross section showing minimum, maximum and average internal radius and average external radius.

Track 6 – Internal radius image

Track 7 – Minimum, maximum and average casing thickness.

Track 8 – Casing thickness image

Track 9 – Acoustic impedance image

Track 10 – Bond Flexural Wave Attenuation image

Track 11 – Interpreted Solid/Liquid/Gas image (brown = cement, blue = liquid, red = gas)

It was also determined that a microannulus does exist in a few places between the casing and cement. This is a condition where the acoustic coupling between the casing and cement has been reduced. The CBL log is the tool most affected by this condition and a CBL log with 500 psi pressure applied to the wellbore fluids was enough to eliminate this condition. Based on the API data on casing expansion this would mean that the microannulus is less than one thousandth of an inch, which is prohibitive to fluid flow. The USIT measurement is the better measurement to use for the analysis in these intervals and it shows very good hydraulic isolation. The USIT part of the Isolation Scanner and the PMIT also show that the casing has no internal or external defects at this time based on the internal radius and thickness measurements.

Mechanical Integrity Tests

Part 730 Underground Injection Control Operating Requirements

Subpart A 730.108 Mechanical Integrity

a) The owner or operator must demonstrate mechanical integrity when required by other Sections.

And Condition H.26 (b) of the permit (Log# UIC-143-M-2)

Mechanical integrity was established several times during the injection well completion. Prior to perforating, the casing was tested by both a low and high pressure test. The low pressure test was to 330 psig and the high pressure test was to 1750 psi. Both tests were recorded for 30 minutes with no bled off for the low pressure test and nine psi bleed off for the high pressure test. This was done on Sept 2, 2009. Upon installation of the lower completion the packer elements were successfully tested to 1040 psig for 30 minutes with no leakoff. This was performed on October 7, 2009 . After the completion brine was spotted and the blanking plug was set in the lower completion the casing above the packer and lower completion was tested overnight to 750 psi with no leak off. This overnight test was performed October 8-9, 2009. During the installation of the upper completion each joint of the injection tubing was hydro-tested to 3500 psi while being run in the hole. This occurred from Nov 13-26, 2009. After installation of the upper completion and packer seal assembly and tubing landed in the well head the annulus was tested to 1000 psi with no leak off however the pressure chart from this test cannot be located and therefore did not meet the requirement of Attachment A, Item I.A. Details of all these tests can be found in the daily as built completion reports.

After installation of the upper well head T3 Energy Services performed a pressure and function tested the tree to 3000 psig on December 2, 2009. To establish mechanical as required H.26 (b) on February 27, 2010 annulus was re-pressured to 1000 psi and was tested for one hour. The casing tubing annulus was full of fluid prior to the test and approximately 50 gallons of annular treated brine was used to bring the pressure to 1000 psig. Test was witnessed and recorded Jim McCain of by McNDT using NIST certified dead weight tester. Details of equipment and test results are in the file box of documents submitted with the completion report. Test was successful with pressure fall off of 5 psig in one hour. The tubing pressure was zero at the surface and downhole tubing pressure was monitored via downhole sensor with no change in downhole tubing pressure. The annulus was tested to 1000 psi as this would be 2.5 times the required annular pressure of 400 psi during injection and down hole annular pressure exceeds the expected downhole injection pressure. A primary focus of the completion and all pressure tests has been provide adequate testing of the wellbore without exposing the casing to unnecessary or excessive pressure and to avoid rapid pressuring and de-pressuring of the casing so as not to cause inadvertent damage to wellbore integrity. Research continues in this area and for CO2 injection wells the current technical leaning is to avoid excessive pressure tests.

Pursuant to Condition H-26, Attachment A, Item I.B. Subsequent test

On Sept 9, 2011 the 4 ½ inch by 9 5/8 inch annulus on the CCS# 1 was pressure tested. The annulus had remained with positive pressure of 8 psig from the test conducted April 27, 2010. The well was initially pressured at 1100 am using a 9.5 ppg NaCl brine with corrosion inhibitor and allowed to stabilize. The tubing pressure was zero and downhole tubing pressure was monitored with the downhole pressure gauge. No change in downhole tubing pressure was noted during the test. Jeff Turner with the IEPA Champaign office arrived at the site at 1330 pm. Jeff Turner was then briefed as to the method of pressurization and inspected the pressure recording equipment. Mr. Turner had previously been provided the certification certificate for the Omega pressure data logger used. The official test was started at 1400 pm with the pressure at 1047.6 psia. The test was monitored and recorded for one hour. The final test pressure at 1500 pm was 1046.6 psia indicating a successful test. Approximately 53.5 gallons of the NaCl brine was used to pressure the annulus and then slowly bled from the well. While at the site Mr. Turner also inspected the annular maintenance system and the instrumentation in place at the CCS#1. Mr. Turner was given a copy of the pressure chart and was subsequently electronically mailed the data from the test.

Conclusion

Based on the analysis of the log data and well test information, this well meets the requirements for mechanical integrity and is protective of groundwater.

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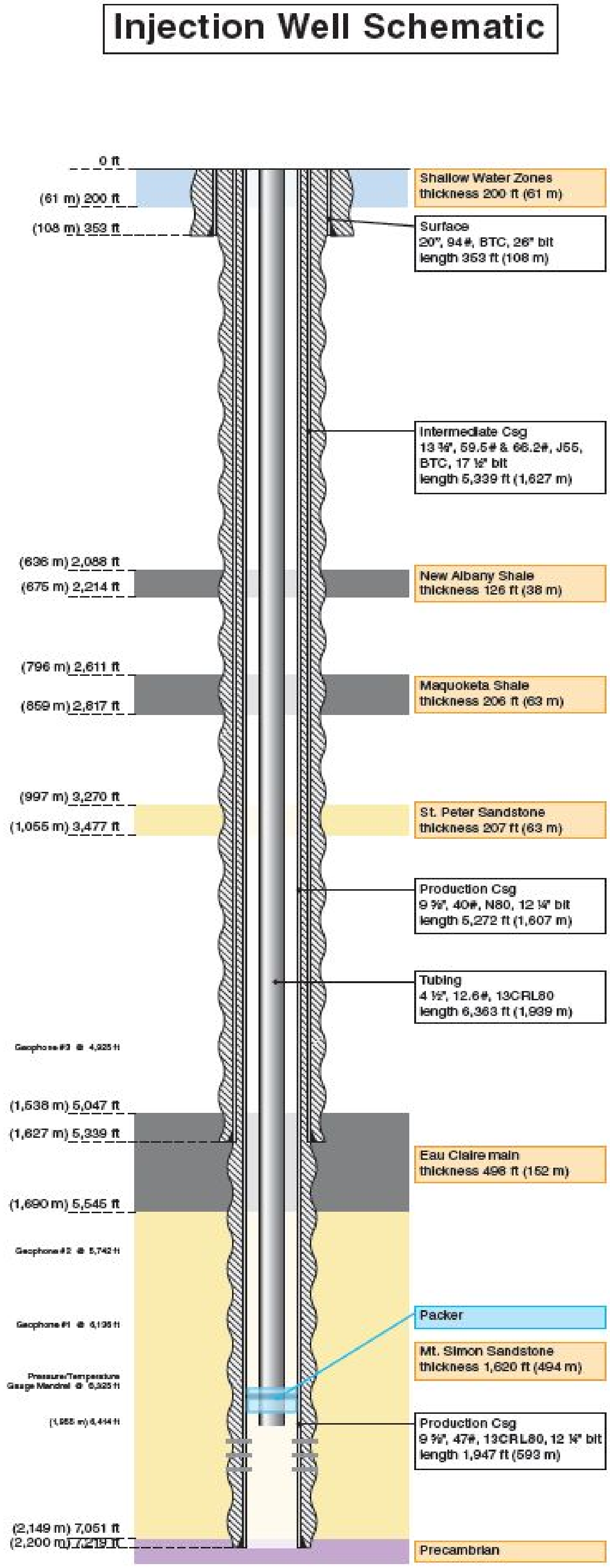

Figure 1 – Wellbore Diagram

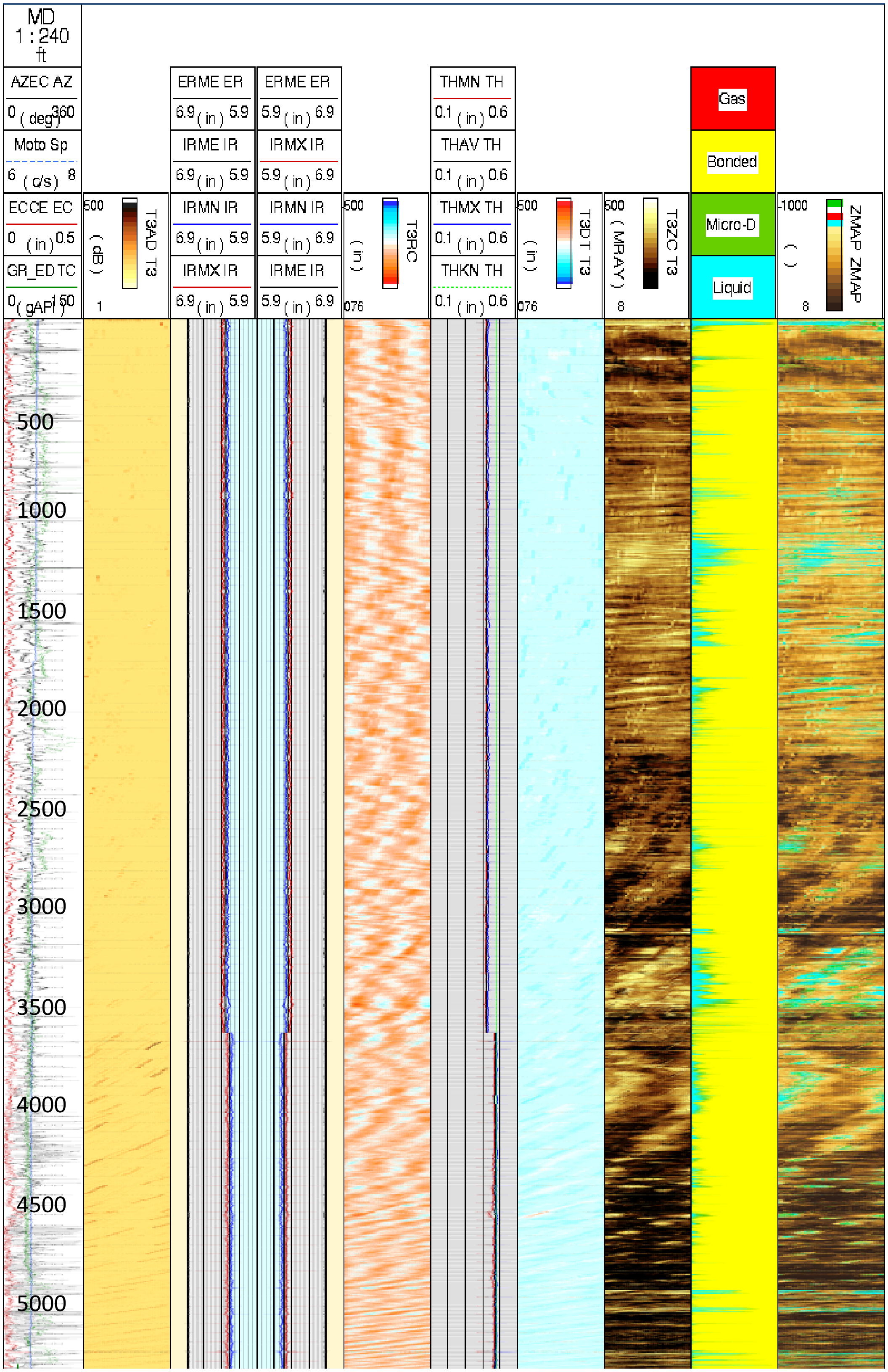

Figure 2 – USIT Intermediate Casing String

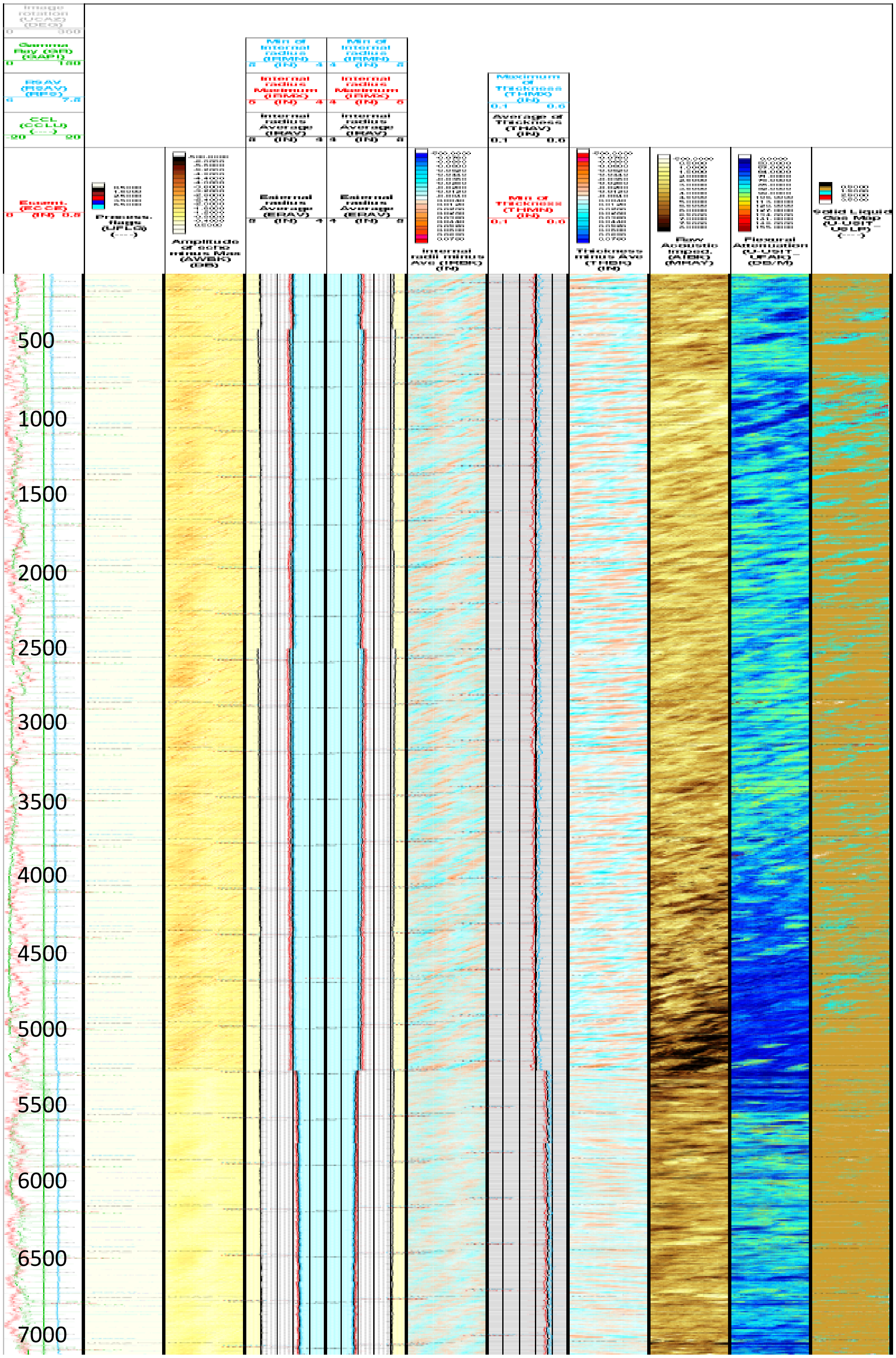

Figure 3 – Isolation Scanner Production Casing String